[redacted]

Coordinated Science Laboratory

UNIVERSITY OF ILLINOIS – URBANA, ILLINOIS

AN EVALUATION OF A BAKEOUT PROCEDURE FOR SMALL GLASS ULTRAHIGH VACUUM SYSTEMS

F. Steinrisser

REPORT R-299 JUNE, 1966

This work was supported in part by the Joint Services Electronics Program (U. S. Army, U. S. Navy, and U. S. Air Force) under Contract No. DA 28 043 AMC 00073(E), and in part by the National Aeronautics and Space Administration under Grant NASA NsG-376.

AN EVALUATION OF A BAKEOUT PROCEDURE FOR SMALL GLASS ULTRAHIGH VACUUM SYSTEMS

Fortunat Steinrisser

Abstract

A bakeout procedure for small glass ultrahigh vacuum systems is described which insures pressures well below 10^{-11} Torr. An optically dense zeolite trap and a valve were placed between diffusion pump and system. The trap was baked whenever it was loaded with gas, i.e., after glassblowing, system bakeout, and outgassing of the ion gauges. The valve between trap and system was kept closed during bakeout of the trap. During bakeout of the system, outgassing of the ion gauges, and regular operation of the system, the trap was refrigerated at liquid nitrogen temperature.

The observed partial pressures are given. Atmospheric He diffusing through the Pyrex glass and H_2 diffusing out of metal parts were the dominant residual gases. CO production during O_2 admission was small in comparison to processing without use of the isolation valve.

System Processing

In a recent communication by J. H. Singleton and W. J. Lange[1] it was reported that the main residual gas in their Pyrex glass systems of about two liters volume was CO_2. The lowest stable pressure was $\sim 5 \times 10^{-11}$ Torr when they processed their systems in the following way: a) trap refrigerated, system baked ~10 h at 420°C; b) trap isolated from system and pumped while baked at ~250°C; c) ion gauge outgassed by electron bombardment. It was observed that the lowest pressure was about one order of magnitude higher when between stages b) and c) the system was baked once more. Diffusion pumps giving an effective pumping speed of ~0.5 ℓ/sec at the systems were used with various pumping fluids.

The performance of some very similar systems (see Figure 1) has been examined in this laboratory during the past two years. They were made from Pyrex glass (Corning 7740) and had a volume of one to three liters. Usually a magnetic deflection type mass spectrometer[2] was included for partial pressure measurements. Bayard-Alpert gauges and Schuemann photocurrent suppressor gauges[3] were used for total pressure measurements. An optically dense zeolite trap filled with approximately 10 g of Molecular Sieve (Linde 13 X) could be refrigerated at liquid nitrogen temperature. A one inch valve served to isolate the trap from the system. Two-stage fractionating oil diffusion pumps (CVC GF-20) were used with Monsanto OS-124 oil; the pump was air cooled, and the pumping speed for N_2 at the system was ~0.5 ℓ/sec.

With the following procedures, pressures below 1×10^{-11} Torr were regularly obtained 2-3 days after exposing the system to atmospheric

pressure: a) The system was pumped with a forepump to $\sim 10^{-3}$ Torr (the valve between system and diffusion pump was kept closed with the diffusion pump always running). Then the valve was opened and the system pumped for several hours with the diffusion pump. b) The trap was valved off from the system and baked at $\sim 350^{\circ}$C for four hours; the glass tubing between valve and trap and the valve were kept at $\sim 150^{\circ}$C to prevent oil condensation. c) The valve was opened after the trap had been refrigerated to liquid nitrogen temperature. Then the system was baked at 350°C for $\sim$10 hours. d) Stage b) was repeated. e) The ion gauges were outgassed at 80 W for six hours. f) Stage b) was repeated. If necessary, the cycle c) to f) was repeated.

Partial Pressures

One of the systems was used for a detailed investigation of partial pressures during system processing. It was repeatedly cycled from atmospheric to very low pressure. It consisted of a Bayard-Alpert gauge WL-5966, a Schuemann photocurrent suppressor gauge of more recent design[4] with a low temperature filament, and a mass spectrometer.[2]

The main residual gas during bakeout of the system and outgassing of the gauges was CO; CO_2 was always less than CO. H_2 was also present and became the major residual gas when the system was close to room temperature.

To obtain low pressures, the gauges and mass spectrometer had to be outgassed at: 50 W (Bayard-Alpert), 120 W (Schuemann) with all metal parts except the filaments connected to the grid, 10 W (ion source of mass spectrometer). Pressures of less than 1×10^{-11} Torr were obtained two days after starting the processing. After three days, the system reached its final pressure in the low 10^{-12} Torr range as measured with the Schuemann gauge. These pressures are in nitrogen equivalent. A further decrease could be observed when the gauges were shut off. Table I gives the dominant partial pressures observed under different conditions. These pressures are actual pressures taking into account the sensitivity of the mass spectrometer for the different gases. Calibrations were made with the Bayard-Alpert gauge in the 10^{-9} Torr region.[5] From a paper by Davis[6] it is known that this mass spectrometer is linear down to the lowest pressures. Helium diffusing through the glass walls is the major component. H_2 is important, too, and very probably arises from the mass spectrometer source region as can be seen from an H_2 increase if the emission current is increased. Davis[6] reports a partial pressure of H_2 of 1 to 1.5×10^{-12} Torr due to outgassing of the mass spectrometer source. Our values are slightly higher because the source was operated at a higher emission current (.5 mA compared to .2).

TABLE I

Partial Pressures of Dominant Gases

Condition	H_2	He	CO
both gauges on	5.0×10^{-12}	8.0×10^{-12}	6.0×10^{-13}
Bayard-Alpert gauge off	4.0×10^{-12}	6.2×10^{-12}	6.0×10^{-13}
both gauges off	4.0×10^{-12}	5.3×10^{-12}	6.0×10^{-13}

The valve between system and pump was closed for eight days in an attempt to see how much gas was collected in the system. All filaments were off.

Table II gives the partial pressures after eight days: a) five min. after turning on the mass spectrometer with the valve closed; b) five min. after opening the valve; c) five hours after opening the valve. The He influx, Q, was calculated to 2.6×10^{-12} Torr ℓ/sec; from the relation $S = Q/P$ at equilibrium, the pumping speed S at $P = 5 \times 10^{-12}$ Torr was found to be $S \cong 0.5$ ℓ/sec. The H_2 evolution was much smaller when the mass spectrometer was off. This supports again the assumption that the heating of the mass spectrometer source by the hot filament is responsible to a large extent for the observed H_2 evolution. As one can see from a comparison of Table II with Table I, the system reached its base pressure again only a few hours after opening the valve.

TABLE II

Partial Pressures in Torr after Closing the Valve between System and Pump for 8 Days

Condition	H_2	He	CO
(a) Valve closed, mass spectrometer on for 5 min.	2.6×10^{-10}	6.6×10^{-7}	8.0×10^{-12}
(b) Valve opened for 5 min.	6.0×10^{-12}	5.4×10^{-12}	8.0×10^{-12}
(c) Valve opened for 5 h	3.4×10^{-12}	5.0×10^{-12}	6.0×10^{-13}

CO-Production during O_2 Admission

In another experiment, the influence of processing upon CO-production during O_2-admission was investigated. Some of the earlier experiments by Schuemann, Segovia and Alpert[7] were repeated. The main difference was the very small CO production rate observed in this experiment if the system was kept oil-free. It was found that it makes a big difference whether the valve and the glass tubing between valve and trap were kept at $\sim 150^{\circ}C$ or at room temperature during bakeout of the trap. In the latter case, there was apparently some oil condensation in the valve and the glass tubing. Oil cracking patterns could be seen immediately after turning on the low temperature filament in the mass spectrometer (Figure 2). Only 15 min. later, the typical oil cracking pattern had disappeared, and only H_2 and CO could be found (Figure 3) in large quantities.

The system still reached pressures in the low 10^{-11} Torr range. In this case, however, the CO pressure reached more than 20% of the O_2 pressure under equilibrium conditions.

When the processing was done as described earlier, i.e. if valve and glass tubing between valve and trap were kept at $\sim 150^{\circ}C$ during bakeout of the trap, the CO pressure was only around 2% of the O_2 pressure under identical conditions. One regular filament in the Bayard-Alpert gauge was replaced by an ultra-pure W filament. With this filament, even lower CO production was observed. In Table III, the CO pressure in percent of O_2 pressure is given under different conditions and for times T = 5 min. and T = 1 day after O_2 admission.

All of our observations are in agreement with results found by [illegible], Becher and Brandes[8] on "Reactions of Oxygen with Pure Tungsten and Tungsten Containing Carbon." Carbon from oil cracking products apparently diffuses into the W filaments. In an oxygen atmosphere, CO is formed on the hot tungsten filament and carbon diffuses out again.

TABLE III

CO Production (in % of O_2, $P_{O_2} \approx 5 \times 10^{-7}$ Torr)

Emission Currents: Mass Spectrometer--1 mA; B.A. Gauge--10 mA

Conditions	% CO (T = 5 min)	% CO (T = 1 day)
Only mass spectrometer on, low temperature filament, no oil	.75	.4
Only mass spectrometer on, W filament, no oil	2.0	.9
B.A. gauge on, regular filament, no oil	2.5	2.1
B.A. gauge on, ultra-pure filament, no oil	1.8	.4
B.A. gauge on, regular filament, with oil	3.0	25.0

Conclusions

1) Small glass ultrahigh vacuum systems with a zeolite trap between diffusion pump and system are capable of pressures in the low 10^{-12} Torr range (nitrogen equivalent).

2) A valve between trap and system is necessary for system processing.

3) With the technique described in this note, pressures below 10^{-11} Torr may be obtained two days after opening the system to air.

4) Bakeout temperatures of 350°C are sufficient for glass systems.

5) CO production in the presence of oxygen and a hot filament can be greatly reduced by this technique.

Acknowledgments

The author would like to thank D. Alpert, A. Dallos, R. N. Peacock, and F. M. Propst for helpful discussions, and W. I. Lawrence for excellent glassblowing work.

REFERENCES

1. J. H. Singleton and W. J. Lange, J. Vac. Sci. Tech. 2, 93 (1965).
2. W. D. Davis and T. A. Vanderslice, Trans. AVS Vac. Symp. 7, 417 (1960).
3. W. C. Schuemann, Rev. Sci. Instr. 34, 700 (1963).
4. W. C. Schuemann, CSL Report R-249 (March 1965).
5. P. A. Redhead, E. V. Kornelsen, and J. P. Hobson, Adv. Electron. Electron Phys. 17, 323 (1962).
6. W. D. Davis, Trans. AVS Vac. Symp. 9, 363 (1962).
7. W. C. Schuemann, J. de Segovia, and D. Alpert, Trans. AVS Vac. Symp. 10, 223 (1963).
8. J. A. Becker, E. J. Becker, and R. G. Brandes, J. Appl. Phys. 32, 411 (1961).

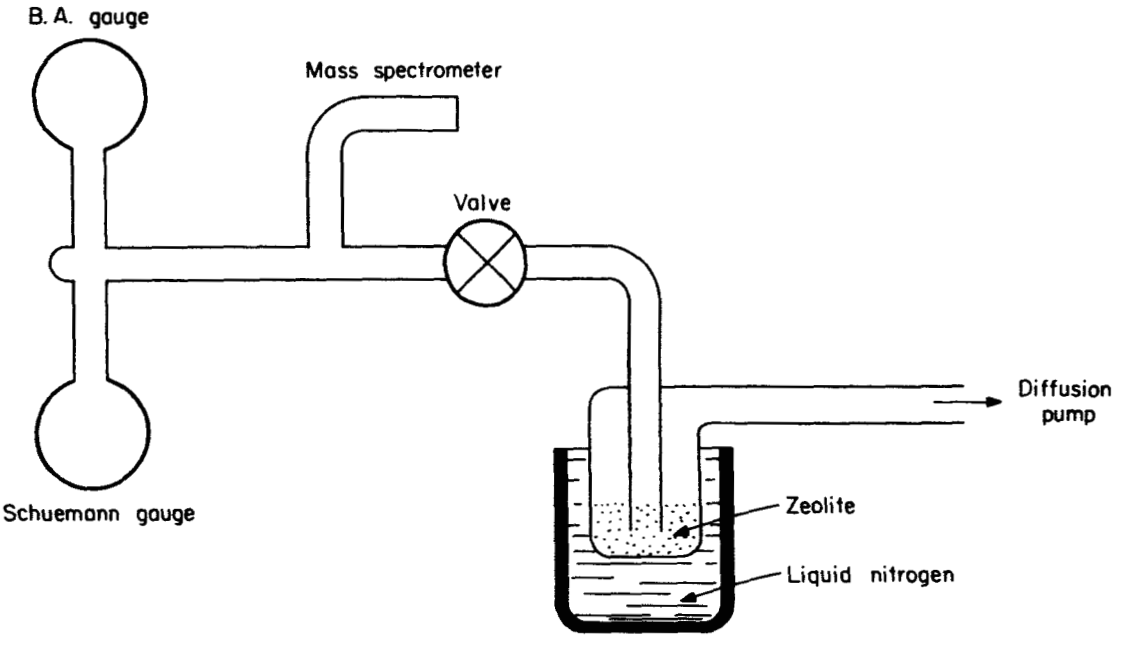

Fig. 1. A schematic view of the vacuum system.

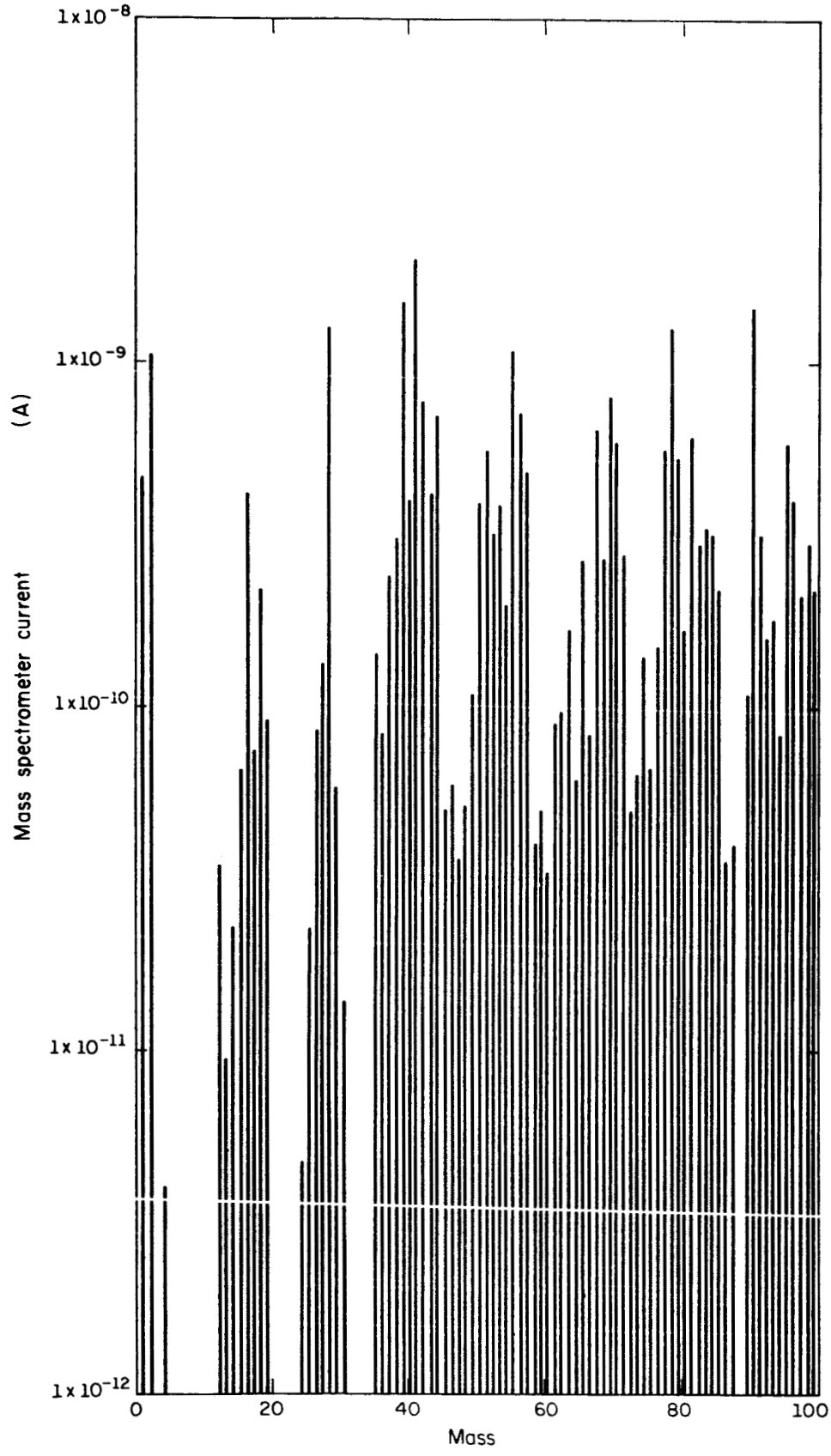

Fig. 2. Mass spectrum with characteristic oil cracking pattern taken immediately after turning on the low temperature filament in the mass spectrometer.

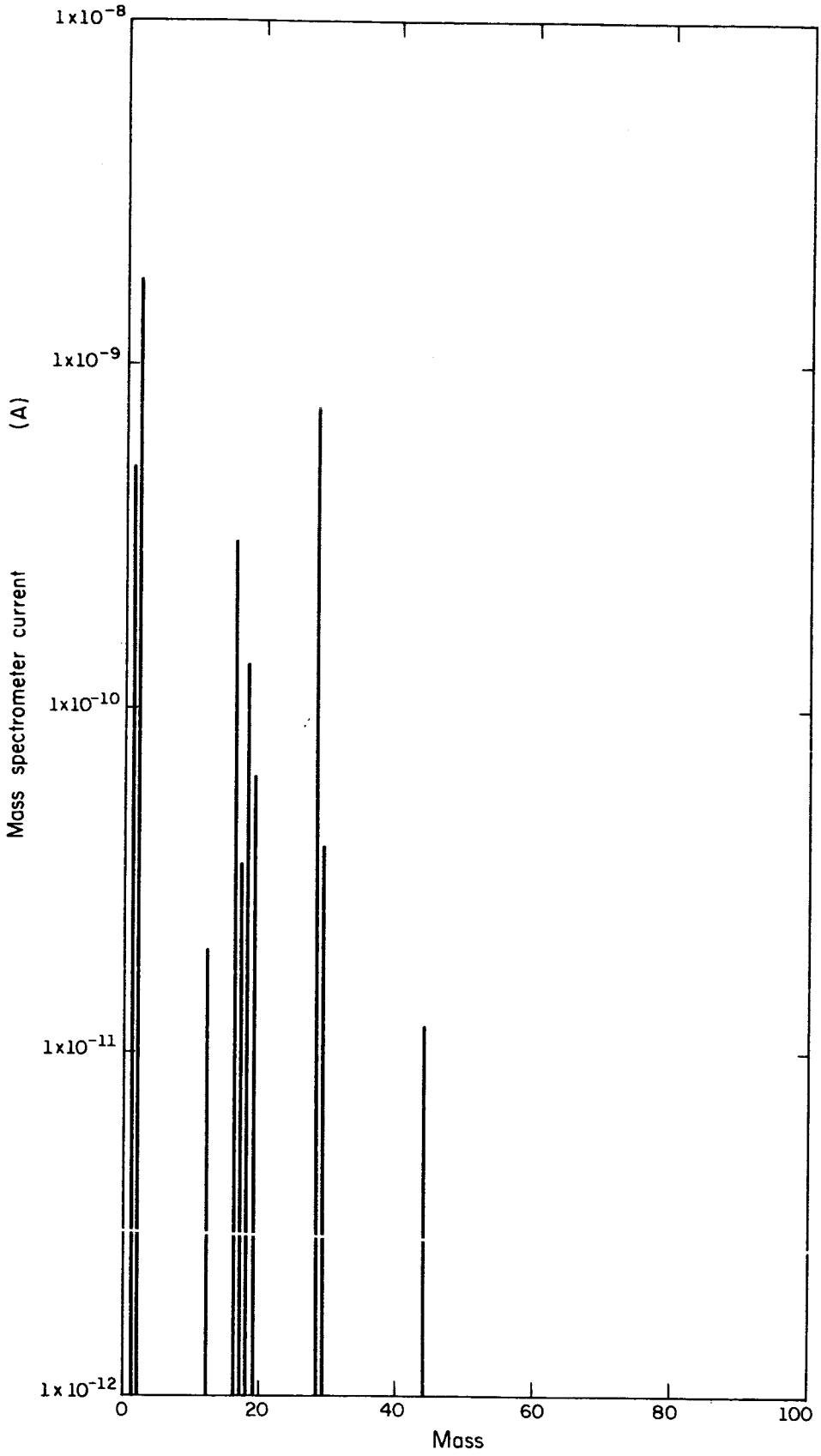

Fig. 3. Same mass spectrum as in Fig. 2, but with the filament on for 20 min. Note that only hydrogen and CO are left in large quantities. The oil cracking pattern has practically disappeared.

Distribution list as of May 1, 1966

1 Dr. Edward M. Reilley
Asst. Director (Research)
Ofc. of Defense Res. & Engrg.
Department of Defense
Washington, D. C. 20301

1 Office of Deputy Director
(Research and Information Rm 3D1037)
Department of Defense
The Pentagon
Washington, D. C. 20301

1 Director
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301

1 Director for Materials Sciences
Advanced Research Projects Agency
Department of Defense
Washington, D. C. 20301

1 Headquarters
Defense Communications Agency (333)
The Pentagon
Washington, D. C. 20305

20 Defense Documentation Center
Attn: TISIA
Cameron Station, Building 5
Alexandria, Virginia 22314

1 Director
National Security Agency
Attn: Librarian C-332
Fort George G. Meade, Maryland 20755

1 Weapons Systems Evaluation Group
Attn: Col. Finis G. Johnson
Department of Defense
Washington, D. C. 20305

1 National Security Agency
Attn: R4-James Tippet
Office of Research
Fort George G. Meade, Maryland 20755

1 Central Intelligence Agency
Attn: OCR/DD Publications
Washington, D. C. 20505

1 AFRSTE
Hqs. USAF
Room 1D-429, The Pentagon
Washington, D. C. 20330

1 AUL3T-9663
Maxwell Air Force Base, Alabama 36112

1 AFFTC (FTBPP-2)
Technical Library
Edwards AFB, California 93523

1 Space Systems Division
Air Force Systems Command
Los Angeles Air Force Station
Los Angeles, California 90045
Attn: SSSD

1 SSD(SSTRT/Lt. Starbuck)
AFUPO
Los Angeles, California 90045

1 Det. #6, OAR (LOOAR)
Air Force Unit Post Office
Los Angeles, California 90045

1 Systems Engineering Group (RTD)
Technical Information Reference Branch
Attn. SEPIR
Directorate of Engineering Standards
& Technical Information
Wright-Patterson AFB, Ohio 45433

1 ARL (ARIY)
Wright-Patterson AFB, Ohio 45433

1 AFAL (AVT)
Wright-Patterson AFB, Ohio 45433

1 AFAL (AVTE/R. D. Larson)
Wright-Patterson AFB, Ohio 45433

1 Office of Research Analyses
Attn: Technical Library Branch
Holloman AFB, New Mexico 88330

2 Commanding General
Attn: STEWS-WS-VT
White Sands Missile Range
New Mexico 88002

1 RADC (EMLAL-I)
Griffiss AFB, New York 13442
Attn: Documents Library

1 Academy Library (DFSLB)
U. S. Air Force Academy
Colorado 80840

1 FJSRL
USAF Academy, Colorado 80840

1 APGC (PGBPS-12)
Eglin AFB, Florida 32542

1 AFETR Technical Library
(ETV, MU-135)
Patrick AFB, Florida 32925

1 AFETR (ETLLG-I)
STINFO Officer (for Library)
Patrick AFB, Florida 32925

1 AFCRL (CRMXLR)
AFCRL Research Library, Stop 29
L. G. Hanscom Field
Bedford, Massachusetts 01731

2 ESD (ESTI)
L. G. Hanscom Field
Bedford, Massachusetts 01731

1 AEDC (ARO, INC)
Attn: Library/Documents
Arnold AFS, Tennessee 37389

2 European Office of Aerospace Research
Shell Building
47 Rue Cantersteen
Brussels, Belgium

5 Lt. Col. E. P. Gaines, Jr.
Chief, Electronics Division
Directorate of Engineering Sciences
Air Force Office of Scientific Research
Washington, D. C. 20333

1 U. S. Army Research Office
Attn. Physical Sciences Division
3045 Columbia Pike
Arlington, Virginia 22204

1 Research Plans Office
U. S. Army Research Office
3045 Columbia Pike
Arlington, Virginia 22204

1 Commanding General
U. S. Army Materiel Command
Attn: AMCRD-RS-PE-E
Washington, D. C. 20315

1 Commanding General
U. S. Army Strategic Communications Command
Washington, D. C. 20315

1 Commanding Officer
U. S. Army Materials Research Agency
Watertown Arsenal
Watertown, Massachusetts 02172

1 Commanding Officer
U. S. Army Ballistics Research Laboratory
Attn: V. W. Richards
Aberdeen Proving Ground
Aberdeen, Maryland 21005

1 Commandant
U. S. Army Air Defense School
Attn: Missile Sciences Division C&S Dept.
P. O. Box 9390
Fort Bliss, Texas 79916

1 Commanding General
U. S. Army Missile Command
Attn: Technical Library
Redstone Arsenal, Alabama 35809

1 Commanding General
Frankford Arsenal
Attn: SMUFA-L6000 (Dr. Sidney Ross)
Philadelphia, Pennsylvania 19137

1 U. S. Army Munitions Command
Attn: Technical Information Branch
Picatinney Arsenal
Dover, New Jersey 07801

1 Commanding Officer
Harry Diamond Laboratories
Attn: Mr. Berthold Altman
Connecticut Avenue & Van Ness Street N. W.
Washington, D. C. 20438

1 Commanding Officer
U. S. Army Security Agency
Arlington Hall
Arlington, Virginia 22212

1 Commanding Officer
U. S. Army Limited War Laboratory
Attn: Technical Director
Aberdeen Proving Ground
Aberdeen, Maryland 21005

1 Commanding Officer
Human Engineering Laboratories
Aberdeen Proving Ground, Maryland 21005

1 Director
U. S. Army Engineer Geodesy, Intelligence
and Mapping
Research and Development Agency
Fort Belvoir, Virginia 22060

1 Commandant
U. S. Army Command and General Staff College
Attn: Secretary
Fort Leavenworth, Kansas 66270

1 Dr. H. Robl, Deputy Chief Scientist
U. S. Army Research Office (Durham)
Box CM, Duke Station
Durham, North Carolina 27706

1 Commanding Officer
U. S. Army Research Office (Durham)
Attn: CRD-AA-IP (Richard O. Ulsh)
Box CM, Duke Station
Durham, North Carolina 27706

1 Superintendent
U. S. Army Military Academy
West Point, New York 10996

1 The Walter Reed Institute of Research
Walter Reed Medical Center
Washington, D. C. 20012

1 Commanding Officer
U. S. Army Electronics R&D Activity
Fort Huachuca, Arizona 85163

1 Commanding Officer
U. S. Army Engineer R&D Laboratory
Attn: STINFO Branch
Fort Belvoir, Virginia 22060

1 Commanding Officer
U. S. Army Electronics R&D Activity
White Sands Missile Range, New Mexico 88002

1 Dr. S. Benedict Levin, Director
Institute for Exploratory Research
U. S. Army Electronics Command
Fort Monmouth, New Jersey 07703

1 Director
Institute for Exploratory Research
U. S. Army Electronics Command
Attn: Mr. Robert O. Parker, Executive
Secretary, JSTAC (AMSEL-XL-D)
Fort Monmouth, New Jersey 07703

1 Commanding General
U. S. Army Electronics Command
Fort Monmouth, New Jersey 07703

Attn: AMSEL-SC
RD-D
RD-G
RD-GF
RD-MAF-I
RD-MAT
XL-D
XL-E
XL-C
XL-S
HL-D
HL-L
HL-J
HL-P
HL-O
HL-R
NL-D
NL-A
NL-P
NL-R
NL-S
KL-D
KL-E
KL-S
KL-T
VL-D
WL-D

3 Chief of Naval Research
Department of the Navy
Washington, D. C. 20360
Attn: Code 427

4 Chief, Bureau of Ships
Department of the Navy
Washington, D. C. 20360

3 Chief, Bureau of Weapons
Department of the Navy
Washington, D. C. 20360

2 Commanding Officer
Office of Naval Research Branch Office
Box 39, Navy No. 100 F.P.O.
New York, New York 09510

3 Commanding Officer
Office of Naval Research Branch Office
219 South Dearborn Street
Chicago, Illinois 60604

1 Commanding Officer
Office of Naval Research Branch Office
1030 East Green Street
Pasadena, California

1 Commanding Officer
Office of Naval Research Branch Office
207 West 24th Street
New York, New York 10011

Distribution list as of May 1, 1966 (cont'd.)

1 Commanding Officer
Office of Naval Research Branch Office
495 Summer Street
Boston, Massachusetts 02210

8 Director, Naval Research Laboratory
Technical Information Officer
Washington, D. C.
Attn: Code 2000

1 Commander
Naval Air Development and Material Center
Johnsville, Pennsylvania 18974

2 Librarian
U. S. Naval Electronics Laboratory
San Diego, California 95152

1 Commanding Officer and Director
U. S. Naval Underwater Sound Laboratory
Fort Trumbull
New London, Connecticut 06840

1 Librarian
U. S. Navy Post Graduate School
Monterey, California

1 Commander
U. S. Naval Air Missile Test Center
Point Magu, California

1 Director
U. S. Naval Observatory
Washington, D. C.

2 Chief of Naval Operations
OP-07
Washington, D. C.

1 Director, U. S. Naval Security Group
Attn: G43
3801 Nebraska Avenue
Washington, D. C.

2 Commanding Officer
Naval Ordnance Laboratory
White Oak, Maryland

1 Commanding Officer
Naval Ordnance Laboratory
Corona, California

1 Commanding Officer
Naval Ordnance Test Station
China Lake, California

1 Commanding Officer
Naval Avionics Facility
[illegible]polis, Indiana

1 Commanding Officer
Naval Training Device Center
Orlando, Florida

1 U. S. Naval Weapons Laboratory
Dahlgren, Virginia

1 Weapons Systems Test Division
Naval Air Test Center
Patuxtent River, Maryland
Attn: Library

1 Mr. Charles F. Yost
Special Assistant to the Director of Research
National Aeronautics and Space Administration
Washington, D. C. 20546

1 Dr. H. Harrison, Code RRE
Chief, Electrophysics Branch
National Aeronautics and Space Administration
Washington, D. C. 20546

1 Goddard Space Flight Center
National Aeronautics and Space Administration
Attn: Library, Documents Section Code 252
Greenbelt, Maryland 20771

1 NASA Lewis Research Center
Attn: Library
21000 Brookpark Road
Cleveland, Ohio 44135

1 National Science Foundation
Attn: Dr. John R. Lehmann
Division of Engineering
1800 G Street, N. W.
Washington, D. C. 20550

1 U. S. Atomic Energy Commission
Division of Technical Information Extension
P. O. Box 62
Oak Ridge, Tennessee 37831

1 Los Alamos Scientific Laboratory
Attn: Reports Library
P. O. Box 1663
Los Alamos, New Mexico 87544

2 NASA Scientific & Technical Information Facility
Attn: Acquisitions Branch (S/AK/DL)
P. O. Box 33
College Park, Maryland 20740

1 Director
Research Laboratory of Electronics
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

1 Polytechnic Institute of Brooklyn
55 Johnson Street
Brooklyn, New York 11201
Attn: Mr. Jerome Fox
Research Coordinator

1 Director
Columbia Radiation Laboratory
Columbia University
538 West 120th Street
New York, New York 10027

1 Director
Coordinated Science Laboratory
University of Illinois
Urbana, Illinois 61801

1 Director
Stanford Electronics Laboratories
Stanford University
Stanford, California

1 Director
Electronics Research Laboratory
University of California
Berkeley 4, California

1 Director
Electronic Sciences Laboratory
University of Southern California
Los Angeles, California 90007

1 Professor A. A. Dougal, Director
Laboratories for Electronics and
Related Sciences Research
University of Texas
Austin, Texas 78712

1 Division of Engineering and Applied Physics
210 Pierce Hall
Harvard University
Cambridge, Massachusetts 02138

1 Aerospace Corporation
P. O. Box 95085
Los Angeles, California 90045
Attn: Library Acquisitions Group

1 Professor Nicholas George
California Institute of Technology
Pasadena, California

1 Aeronautics Library
Graduate Aeronautical Laboratories
California Institute of Technology
1201 E. California Boulevard
Pasadena, California 91109

1 Director, USAF Project RAND
Via: Air Force Liaison Office
The RAND Corporation
1700 Main Street
Santa Monica, California 90406
Attn: Library

1 The Johns Hopkins University
Applied Physics Laboratory
8621 Georgia Avenue
Silver Spring, Maryland
Attn: Boris W. Kuvshinoff
Document Librarian

1 Hunt Library
Carnegie Institute of Technology
Schenley Park
Pittsburgh, Pennsylvania 15213

1 Dr. Leo Young
Stanford Research Institute
Menlo Park, California

1 Mr. Henry L. Bachmann
Assistant Chief Engineer
Wheeler Laboratories
122 Cuttermill Road
Great Neck, New York

1 University of Liege
Electronic Department
Mathmatics Institute
15, Avenue Des Tilleuls
Val-Benoit, Liege
Belgium

1 School of Engineering Sciences
Arizona State University
Tempe, Arizona

1 University of California at Los Angeles
Department of Engineering
Los Angeles, California

1 California Institute of Technology
Pasadena, California
Attn: Documents Library

1 University of California
Santa Barbara, California
Attn: Library

1 Carnegie Institute of Technology
Electrical Engineering Department
Pittsburgh, Pennsylvania

1 University of Michigan
Electrical Engineering Department
Ann Arbor, Michigan

1 New York University
College of Engineering
New York, New York

1 Syracuse University
Department of Electrical Engineering
Syracuse, New York

1 Yale University
Engineering Department
New Haven, Connecticut

1 Airborne Instruments Laboratory
Deerpark, New York

1 Bendix Pacific Division
11600 Sherman Way
North Hollywood, California

1 General Electric Company
Research Laboratories
Schenectady, New York

1 Lockheed Aircraft Corporation
P. O. Box 504
Sunnyvale, California

1 Raytheon Company
Bedford, Massachusetts
Attn: Librarian

Security Classification

DOCUMENT CONTROL DATA R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
University of Illinois
Coordinated Science Laboratory
Urbana, Illinois 61801

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE

AN EVALUATION OF A BAKEOUT PROCEDURE FOR SMALL GLASS ULTRAHIGH VACUUM SYSTEMS.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (Last name, first name, initial)
Steinrisser, Fortunat

6. REPORT DATE
June, 1966

7a TOTAL NO. OF PAGES
12

7b. NO. OF REFS.
8

8a. CONTRACT OR GRANT NO.
DA 28 043 AMC 00073(E)

b. PROJECT NO.
20014501B31F

c. Also National Aeronautics and Space Administration under Grant

d. NASA NsG-376.

9a. ORIGINATOR'S REPORT NUMBER(S)
R-299

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. AVAILABILITY/LIMITATION NOTICES

Distribution of this report is unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY
Joint Services Electronics Program
thru U. S. Army Electronics Command
Ft. Monmouth, New Jersey 07703

13. ABSTRACT

A bakeout procedure for small glass ultrahigh vacuum systems is described which insures pressures well below 10^{-11} Torr. An optically dense zeolite trap and a valve were placed between diffusion pump and system. The trap was baked whenever it was loaded with gas, i.e., after glassblowing, system bakeout, and outgassing of the ion gauges. The valve between trap and system was kept closed during bakeout of the trap. During bakeout of the system, outgassing of the ion gauges, and regular operation of the system, the trap was refrigerated at liquid nitrogen temperature.

The observed partial pressures are given. Atmospheric He diffusing through the Pyrex glass and H_2 diffusing out of metal parts were the dominant residual gases. CO production during O_2 admission was small in comparison to processing without the use of the isolation valve.

DD FORM 1 JAN 64 1473

Security Classification

Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
very low pressures ultrahigh vacuum systems uhv techniques						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through

_____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through

_____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through

_____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.

DD FORM 1 JAN 64 1473

Security Classification